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A New Approach to Managing the Army Selective Reenlistment Bonus

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U. S. Army
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> The authors develop a theoretical model of profit maximization in which the Selective Reenlistment Bonus (SRB) is treated as a wage premium payable to servicemen who are more productive, more costly to recruit and train, and less likely to continue in the Army in the absence of the SRB. Empirical estimation of the model is based on measuring a serviceman's productivity (in terms of his civilian counterpart's occupational wage), recruitment and training costs, and separation rates. Multiple regression equations are used to estimate civilian wages (a proxy for productivity) as a function of (Continued)

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civilian occupation, education, and age of the worker. The empirical model groups Military Occupational Specialties (MOS) into three categories--Combat Arms, Technical, and Support Services.

The results for servicemen in grade E-4 reveal that the average SRB calculated by the model ($5,247) should be about the same as the actual payments ($5,297) for servicemen in Combat Arms, but should be higher ($7,308) compared to the actual ($5,312) for Technical occupations, and lower ($1,942) compared to the actual ($3,757) payments in the Support Services.

The research shows that retention rates in Technical MOS can be raised by increasing the SRB. The required increase in SRB expenditures can be funded by reducing SRB payments in the Support Services. Keywords:

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A NEW APPROACH TO MANAGING THE ARMY SELECTIVE REENLISTMENT BONUS

EXECUTIVE SUMMARY

Requirement:

The U.S. Army Research Institute conducts research on manpower, personnel, and training issues of particular significance and interest to the U.S. Army. The objective of this research was to develop a basis for the reenlistment bonus that would improve its effectiveness and efficiency.

Procedure:

The authors develop a theoretical model of profit maximization in which the selective reenlistment bonus (SRB) is treated as a wage premium payable to servicemen who are more productive, more costly to recruit and train, and less likely to continue in the Army in the absence of the SRB. Empirical estimation of the model is based on measuring a serviceman's productivity (in terms of his civilian counterpart's occupational wage), recruitment and training costs, and separation rates. Multiple regression equations are used to estimate civilian wages (a proxy for productivity) as a function of civilian occupation, education, and age of the worker. The empirical model groups Military Occupational Specialties (MOS) into three categories--Combat Arms, Technical, and Support Services.

Findings:

The results for servicemen in grade E-4 reveal that the average SRB calculated by the model ($5,247) should be about the same as the actual payments ($5,297) for servicemen in Combat Arms, but should be higher ($7,308) compared to the actual ($5,312) for Technical occupations, and lower ($1,942) compared to the actual ($3,757) payments in the Support Services.

Utilization of Findings:

The research shows that retention rates in Technical MOS can be raised by increasing the SRB. The required increase in the SRB expenditures can be funded by reducing SRB payments in the Support Services.

A NEW APPROACH TO MANAGING THE ARMY SELECTIVE REENLISTMENT BONUS

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Chapter 1: Introduction

In recent years the military services have offered bonuses to induce reenlistment in military occupational specialties (MOSs) where supply has fallen short of requirements. The need for reenlistment bonuses stems from the way in which military pay is structured.[1] The most important element of military pay, i.e., basic pay, is based on skill attainment and level of responsibility which vary by pay grade but not by MOS, holding pay grade constant. However, at a given pay grade not all military occupations are equally attractive, either to those who view military service as a potential career or to those who view it as a temporary job in which training can be obtained and skills transferred to the civilian sector. Hence, workers with a given skill proficiency can often earn more in the civilian sector where supply and demand conditions determine wage rates than they can in the military. Since basic pay in a given pay grade is invariant among MOSs, reenlistment bonuses provide a means of aligning military and civilian compensation, thereby making military service more attractive.

In managing a reenlistment bonus program, a number of questions must be addressed. For example, how many dollars should be spent on reenlistment bonuses? What criteria should be used in determining the occupational specialties in which a bonus will be offered? Given that a bonus is offered in an occupational specialty, what amount should be offered? Should the bonus be offered to all takers in an MOS in which it is offered, or should preference be given to some groups? Additionally, attention must be given to effectiveness and efficiency. The effectiveness of the SRB program means how well additional income is distributed to those groups whose labor services are most important in meeting the Army's manpower objectives. For a bonus program to be efficient, bonuses should be offered only to those who would not reenlist in the absence of such a program. To the extent that bonuses are given to individuals who would reenlist even without a bonus, the cost of the bonus program will be greater than necessary. But in formulating policies to insure that a bonus program is effective and efficient, consideration needs also to be given to other aspects of bonus management. For example, bonuses which are offered for a short time and then withdrawn may not provide an adequate signal indicating career opportunities in a given occupational specialty. Also, bonuses should be tied to an individual's performance in addition to serving as a monetary inducement to reenlist.

The first objective of this research is to develop a reenlistment bonus methodology which improves on the effectiveness and efficiency of current SRB procedures. The main building block of this methodology is a model which relates pay to output, training costs, and turnover in competitive labor markets. In the pages that follow, this model is applied to the reenlistment bonus problem whose setting is the military labor market where pay is administratively determined by Congress and taken as given by military manpower managers.

The output of the model is a set of values that yield an effective reenlistment bonus schedule defined in terms of MOS, pay grade, and

SRB zone. Efficiency is indirectly built into the model by providing larger bonuses to individuals who are less likely to reenlist. It should be noted, however, that the model does, by and of itself, enable one to determine the optimal reenlistment bonus budget necessary to meet the Army's manpower goals.

The second objective of the research is to explore policy issues relating to the way in which reenlistment bonuses are currently determined. This analysis will provide insights into some desirable properties which should be exhibited by an SRB program. In the course of the discussion it will be seen that the proposed SRB methodology incorporates a number of these desirable properties.

In the chapters that follow, a number of related topics are discussed. Chapter 2 describes briefly the use of regression models to determine the supply elasticity of the SRB and how such models fit into the more general framework of managing an SRB program.

In Chapter 3, past and current reenlistment policies which have shaped the structure of the Army's SRB program are examined. These policies are analyzed within the broad context of SRB program management.

The basic model utilized for computing proposed SRB levels is discussed in Chapter 4. The model is then expanded to accommodate management criteria to fit the military context in which it is being applied.

The inputs to the model are described and summarized in Chapters 5, 6, and 7. These inputs are the separation rate, training cost, and output associated with each pay grade and bonus zone for specified kinds of labor.[2]

The full model for calculating SRB bonus levels utilizes several filters which modify the initial SRB calculation. The first of these filters measures the military essentiality of a MOS. The second identifies those instances where a MOS is in short supply. A third utilizes information about an individual's performance in the Army to improve the efficiency of the SRB. The last filter adjusts the computed SRB levels so that their range is consistent with that of the FY 1981 SRB schedule. Each of these filters is discussed in Chapter 8.

The SRB levels computed using the model developed in this study are summarized in Chapter 9. The conclusion and suggestions for further research in the management of the Army's SRB program are provided in Chapter 10.

Chapter 1 Footnotes

1 This need is apparent in an all-volunteer military environment but was recognized as early as 1965 when the draft was still in force. In 1965 Congress established the variable reenlistment bonus program as a means of increasing retention in short-supply technical specialties. See U.S. Department of Defense, Office of the Secretary of Defense, Military Compensation Background Papers: Compensation Elements and Related Manpower Cost Items, Their Purpose and Legislative Background, Third Quadrennial Review of Military Compensation, August 1979. (Referred to below as Third Quadrennial Review of Military Compensation).

2 Unless otherwise stated all data in this report were obtained from the Defense Manpower Data Center (DMDC) in Monterey, California. Their generous assistance is gratefully acknowledged.

Chapter 2: Reenlistment Models and the Selective Reenlistment Bonus

In this chapter we describe one way in which the SRB problem can be addressed, namely, by using a regression model designed to estimate the elasticity of reenlistment with respect to bonuses. The advantages of and problems in using such an approach for setting SRB levels are discussed below within the larger context of the problem of SRB program management.

In order to put the SRB problem in its proper perspective, we begin with a discussion of how the demand for and supply of personnel in an MOS are determined. Put most simply, the demand for personnel in an MOS, D, can be considered as given by strategic and technological considerations.[1] While this approximation holds for the short run, it is clear that in the long run demand cannot be divorced from supply, since shortfalls in personnel may lead to changes in the design of field equipment and ultimately to changes in personnel requirements. For purposes of determining SRBs, personnel requirements are treated as a fixed parameter.

In the absence of a SRB, the reenlistment rate, designated by m, depends on a number of variables expressed as:

(1) $$m = a + bw + \sum_i d_i x_i$$

where w is the military wage, the x_i are variables such as level of education, marital status, race, the opportunity cost of remaining in the military, and the coefficients b and d_i measure the change in m for unit changes in w and the x_i, respectively.

When a SRB, denoted by s, is offered

$$m = a + bw + cs + \sum_i d_i x_i \quad (2)$$

The coefficient c measures the change in the reenlistment rate m for a unit change in s, holding everything else constant. The elasticity of reenlistment with respect to the bonus is defined as the percentage change in the reenlistment rate when the bonus level changes by one percent.[2]

The supply of career personnel in an MOS can be written as

$$S = mR + F \quad (3)$$

where F represents reenlistees who have passed a length of service threshold sufficiently long so that they will remain in the Army until retirement, R represents the personnel who are potential candidates for reenlistment, i.e. potential careerists, and as before m is the proportion of R who reenlist.

Assuming that equation (3) is correctly estimated, it is useful to inquire as to how it can be utilized in establishing SRB levels. Presumably the bonus "payoff" is higher in MOSs with a high reenlistment elasticity, and hence it can be argued that larger SRBs should be offered in these MOSs. One problem with this approach is that the reenlistment elasticity, by and of itself, does not provide sufficient information to determine whether a bonus should be offered, since the MOSs with a high reenlistment elasticity may already be adequately staffed with career personnel, i.e. in these MOSs it may be that $D > S$. Put another way, it is not clear why MOSs with a high reenlistment elasticity would also necessarily be those MOSs in which there is a shortfall in career personnel. One solution to this problem is to offer an SRB only in those MOSs where there is a shortfall. While this is an acceptable way of resolving this particular problem, it should be recognized that if the unconstrained outcomes differ markedly from the constrained ones, the solution is achieved through a rule which overrides the model rather than by the model itself.

If an SRB is given only in those MOSs where there is a shortfall, the reenlistment regression model can provide a simple, but not necessarily preferred way of insuring that $D = S$ in each occupational specialty. Given the percentage increase in reenlistments that would equate demand and supply in an MOS and knowing the reenlistment elasticity with respect to the bonus, one can compute the SRB level which sets $D = S$. Of course, it may be that the SRBs determined in this manner are greater than the budgeted amount. In this event, which is not unlikely, one is confronted with the problem of how to reduce SRB levels to fit the specified budget.

When estimated SRB expenditures exceed the budget, the natural inclination is to reduce the SRB levels in those MOSs with the lowest reenlistment elasticities. This, however, can lead to unanticipated and unwanted consequences. The reason for this is that the MOSs in which it is most important that incumbents continue in their specialty may be the ones with the lowest reenlistment elasticity with respect to the bonus. Those MOSs are likely to be the ones which are unattractive, either because they do not engender skills that can be transferred to the civilian sector or the skills can be easily transferred to the civilian sector at pay rates that are substantially higher than in the military sector. In these circumstances individuals may be reluctant to reenlist unless a very high bonus is offered. Thus rather than reducing SRB levels in these MOSs, it may be desirable to raise them in order to meet readiness requirements.

In addition to the difficulty of framing appropriate SRB policy based only on reenlistment elasticity information, there are several issues which must be addressed in estimating reenlistment elasticities. Among the more important issues is how the data used in the estimation process are to be aggregated. In the early literature, grouped data were examined using a simple linear or log linear model. More recently as data sets with information for individuals have become available, more complex models, e.g., logit and probit models, have been employed. When similar explanatory variables are utilized, these different models yield different reenlistment elasticities with respect to pay.[3]

There is also some question as to how to define the pay variable.

Some investigators use a relative pay measure, i.e., military pay/civilian pay; others use an absolute measure, i.e., they treat military and civilian pay as separate variables. The latter procedure results in higher pay elasticity estimates than the former.[4] Moreover, military and civilian pay can be defined in different ways. In defining military pay three- or four-year time horizons are generally used, but longer ones are also possible. In estimating civilian pay, civilian workers with similar characteristics as potential reenlistees are typically looked at; however, it is what non-reenlistees actually earn in the civilian sector which is the more relevant proxy of the opportunity cost of remaining in the military. Reenlistment elasticities are higher for longer time horizons and when veterans' earnings are used instead of the earnings of their civilian counterparts.[5]

The reenlistment elasticity also depends on the type of data used and how it is aggregated. Longitudinal data on individuals yield lower elasticity estimates than cross-sectional data.[6] Cell aggregation, e.g., using career management fields (CMFs) instead of MOSs reduces the variance of the occupational variable and also leads to lower elasticity estimates.[7]

Still another problem in estimating reenlistment elasticities is model specification. Whereas all models take into account such variables as age and educational attainment, most omit other variables which may be equally important, e.g., the variety of training an individual receives may influence his perception of multiple career opportunities in the military.[8] Other non-economic factors which may bear on the reenlistment decision come readily to mind.[9]

Besides these problems which affect the accuracy of reenlistment elasticities, there are data problems which must be dealt with. First, data specific to each service is required. Second, bonus elasticities are needed by occupational specialty and zone.[10] Third, it is generally assumed that the impact on reenlistment of a SRB is the same as that of a change in the military wage, i.e., the SRB is subsumed into the wage variable. Not only is the SRB variable omitted from most models, but the dependent variable typically includes all reenlistments whether or not they meet the SRB extension of service requirement, i.e., extension of one's current contract for a minimum of three _additional_ years of service.

Despite the difficulties in estimating reenlistment elasticity models with respect to a SRB, they are useful for achieving consistency between expected SRB expenditures and the actual bonus budget. SRBs can be established in a rational manner without recourse to such models, however. The approach developed in this study is designed to achieve this objective.

Chapter 2 Footnotes

1 For the SRB problem the demand for personnel is for career personnel, which conventionally refers to personnel with 4 or more years of service. In practice, however, the Army offers SRBs to individuals with 21 or more months of service.

2 In a number of models w is expressed as the ratio of the military wage to the civilian wage. Additionally, the bonus is often included in the military wage. In this case the elasticity of reenlistment with respect to the bonus and to the military wage are assumed to be the same.

3 See William R. Bowman and George Thomas, Forecasting Reenlistment Rates in the AVF Era: Methodological Issues and Preliminary Results, United States Naval Academy, 1982, p. 8.

4 _Ibid_., p. 10.

5 _Ibid_., p. 8.

6 _Ibid_., p. 15.

7 _Ibid_., p. 8. For additional discussion of methodological issues involved in estimating reenlistment elasticities, see Thomas V. Daula and Thomas W. Fagan, Modelling the Retention Behavior of First-Term Military Personnel: Methodological Issues and a Proposed Specification, United States Military Academy, 1982.

8 See Sheldon E. Haber, Terence Ireland, and Herbert Solomon, Manpower Policy and the Reenlistment Rate, The George Washington University, Serial T-1201, June 1974.

9 See, for example, Bowman and Thomas, _op.cit._ and Donald Atwater and Murray Rowe, A Method for Estimating the Effects of Military Compensation on Retention, Navy Personnel Research and Development Center, October 25, 1982.

10 Currently, the Department of Defense (DoD) provides _service-wide_ reenlistment rates for zone A. No estimates disaggregated by occupational specialty are available. See U.S. Department of Defense, Office of the Assistant Secretary of Defense, Manpower, Reserve Affairs, and Logistics, Administration of Enlisted Personnel Bonus and Proficiency Pay Programs, DoD Instruction 1304.22, October 1, 1978.

Chapter 3: Selective Reenlistment Bonus Management

The necessity for offering reenlistment bonuses has been recognized ever since the nation's military service was organized.[1] In 1949 the rules for conferring reenlistment bonuses, which at that time were given to <u>all</u> reenlistees irrespective of which MOS they reenlisted in, were considerably improved by basing the amount of the bonus on reenlistment length rather than on length of service in the military. In 1954 the reenlistment bonus level was reduced for individuals reenlisting more than once, since retention rates rise with length of service even in the absence of a bonus. A further improvement was made in 1965 when, in addition to the regular reenlistment bonus (RRB), a variable reenlistment bonus (VRB) was authorized for individuals reenlisting in critical skill occupations. Recognizing that the RRB was being paid to individuals serving in MOSs where retention was high as well as in MOSs where it was low, the RRB was replaced by the SRB in 1974. At the same time the VRB was phased out since its objective and that of the SRB were similar.[2]

This brief outline of the antecedents of the SRB program illustrates major fundamental changes in bonus management as it pertains to improving retention in the military. The proposals made in this study have a more limited objective, i.e., to improve the effectiveness and efficiency of the SRB within the current framework. While the model developed to meet this objective utilizes Army data, it is believed that the general approach is also applicable to the other military services.

A. Current SRB Guidelines

Selective reenlistment bonuses are now offered in three zones. Reenlistments falling between 21 months and 6 years, 6 and 10 years, and 10 and 14 years of active service are defined as occuring in zones A, B, and C, respectively. One of six levels of skill criticality, indicated by bonus multiples 1 through 6, may be designated in each zone. The bonus level is given by the product of the bonus multiple, an individual's monthly basic pay, and the additional years of active service, not to exceed 6 years, which are obligated. No bonus is offered where the "bonus multiple" is 0.

Several management rules must be met for a candidate to qualify for an SRB. The individual must be in pay grade E-3 or higher, must be eligible for reenlistment, must be qualified in an MOS where an SRB is offered, and must reenlist or extend service in that MOS.[3] Moreover, the individual must reenlist or extend for at least 3 years of additional service, and the reenlistment or extension period plus existing prior active service must add to at least 6 years, 10 years, or 14 years of service in zones A, B, and C, respectively.[4] Only one SRB can be awarded in each zone, and beginning in FY 1981 the maximum bonus in a zone was set at $16,000.[5] Since January 1982 one-half of the SRB is paid upon reenlistment, the remainder being paid in equal annual installments over the reenlistment or extension contract; prior to this date the SRB was paid in one lump sum.

In assessing these guidelines, it is useful to determine the outcomes which are implicit in the way they are framed. For example, by offering a SRB only when the additional years of active obligated service exceed 3 years, a minimum number of extra years of service is guaranteed during which the bonus can be recouped. Tying the bonus level to the number of extra years of service also serves as an inducement to reenlist or extend for more than the minimum required to become a candidate for the SRB. This inducement is further strengthened by limiting to one the number of bonuses that can be offered in each zone.

The designation of three zones presumably is to take account of variations in the reenlistment rate and shortfalls during the first and subsequent reenlistment periods. Indeed, the generally high reenlistment rates among individuals with extensive service is consistent with the zone C upper bound of 14 years of service. All else being the same, the positive relationship between the reenlistment rate and length of service suggests that, on average, the bonus multiple should decline in moving from one zone to the next. Likewise, the number of MOSs in which an SRB is offered should diminsh.

Another outcome of the current guidelines, resulting from the use of a constant bonus multiple in a zone, is that within each zone a bigger bonus is offered to individuals in the higher pay grades because of their higher basic pay. But since pay grade and the reenlistment rate are positively related to length of service, a larger proportion of individuals may be expected to reenlist in the higher pay grades than in the lower ones in the absence of the bonus. Hence, everything else being the same, the efficiency of the SRB may be improved if the bonus multiple <u>declined</u> with pay grade <u>within</u> a zone.

The basic philosophy of the SRB program is to offer a SRB only "in skills with chronic retention problems and/or service manning shortages."[6] While there is no doubt that this is the primary intention of the program, the major goal has been elsewhere described as providing "a monetary incentive to encourage personnel to reenlist in military skills which have high training costs and which are in critical supply."[7]

The DoD also considers two additional criteria in their review which deserve separate mention because they pull in different directions. One pertains to "improvements to be expected at various bonus levels,"[8] i.e., the incremental gain in the reenlistment rate or bonus yield consequent upon a change in the bonus multiple. The other states "the appropriate level for a bonus...is determined by the amount of increased retention needed to overcome or alleviate the shortage...in zones within a skill."[9] As indicated earlier, for some MOSs both the bonus yield and retention rate may be low; in these cases it is not clear which criterion should be given the greater weight. Again it is important to recognize that consideration of the bonus yield by and of itself may result in an undesired outcome.

Similarly, the maningfulness of a shortfall depends on factors other than the fill rate. For example, the implications of a given shortfall in an MOS with a high training cost will be different from the same shortfall in an MOS with a low training cost. Thus it is conceivable that one may want to stockpile personnel in the former MOS (resulting in a fill rate exceeding one) and to do so by offering a SRB. Here again it is useful to look at SRB levels absent overrides such as shortfalls.

The problem of giving overriding weight to any single criterion, such as shortfalls, is that it ignores other variables which also need to be considered. The difficulty of incorporating several variables in a decision model, however, is how to combine them. One approach to this problem is to use a multiplicative model. For example, Griffin, in addressing the problem of first-term attrition, develops an attrition severity index which is the product of five variables, the product being scaled between the values of 0 and 1.[10] In another study including similar variables, the variables were themselves scaled between 0 and 1 and then weighted by an "importance factor" (also scaled betwen 0 and 1) from questionnaire information.[11] The weighted values are then used in a linear programming model to obtain SRB multiples.

In this paper a human capital theory model, relating separation rates, training costs and output in the military, is utilized to compute a SRB. The bonus levels are computed from an analytical model and represent wage differentials measured in dollars per year. Discussion of this model is deferred to the next chapter.

B. A Digression on Classification of Career Management Fields and Military Occupational Specialties into Major Army Occupation Groups

Before examining empirical data relating to the current SRB program we first digress to look at the problem of how to summarize such information. One way of summarizing the data is by career management field (CMF). Using CMF categories there are still 31 groupings, hence a simpler method of aggregation must be resorted to. The mapping used in this study leaves the traditional MOS to CMF classification undisturbed.

In this report each CMF is assigned to one of three occupational groups denoted as Infantry (I), Technical (T), or Support (S) (referred to below as major Army occupational groups or more simply as major IDOS groups). The procedure for doing this was as follows:

(1) Each MOS was classified into a two-digit subgroup defined by the Integrated Defense Occupational Stratification (IDOS) system developed by DoD as a means of cross-referencing civilian and military workers.[12]

(2) The enlistees in each MOS within a CMF were then aggregated on the first digit of the IDOS subgroup code into the three major groupings Infantry, Technical, and Support (see Table 3-1).

The IDOS subgroup codes comprising the Infantry, Technical, Support specialties are

IDOS subgroup codes T and R -- Infantry:

Military-Unique Personnel (T)* -- Personnel in occupations with no civilian equivalent, e.g., infantrymen and artillerymen

Laborers, Operators, and Routine Maintainers (R) -- Personnel who operate equipment and provide labor and routine maintenance in transportation, supply, and installation areas

IDOS subgroup codes G and P -- Technical:

Technical Personnel (G) -- Personnel in areas that require extensive special training, e.g., scientific and engineering technical personnel and intelligence technical personnel

Craftsmen, Mechanics, and Production Workers (P) -- Personnel able to install, maintain, repair, or fabricate material and equipment

* First digit of IDOS subgroup in parenthesis.

IDOS subgroup codes J and M -- Support:

> Clerical Personnel (J) -- Personnel who perform typing and filing and operate office equipment
>
> Service Personnel (M) -- Personnel who provide security, medical, and domestic and personal services

(3) Each CMF was then assigned to the major Army occupational group with the largest proportion of the CMF's personnel. As a result of this last step, all MOSs in a CMF are in the major IDOS group of the parent CMF.

To illustrate the procedure it is seen from Table 3-1 that 53.3 percent of the personnel in CMF 51, General Engineering, are in the Technical specialties; the remaining personnel are in the Infantry (44.1 percent) and Support (2.5 percent) specialties. This CMF was assigned to the major occupational group "Technical" personnel since it contains a plurality of the personnel. The same plurality rule was used to categorize each CMF.

While this mapping of CMFs (and MOSs) to major Army occupational group can be viewed simply as an accounting detail, it is some interest to note that most CMFs are homogeneous with respect to the IDOS classification system, but some are not. No attempt is made in this study to reduce the heterogeneity inherent in the IDOS classification system since this would mean departing from the way the Army groups MOSs by CMF.

Table 3-1
Percent Distribution of Enlistees within Major Army Occupational Group by Career Management Field[a]

Career Management Field	Major Army Occupational Group				Military Essentiality Code[d]
	I[b]	T	S	Total[c]	
Infantry (11)[e]	100.0*			100.0	1
Combat Engineering (12)	6.3	93.7*		100.0	1
Field Artillery (13)	65.8*	34.2		100.0	1
Air Defense Artillery (16)	92.0*	8.0		100.0	1
Armor (19)	100.0*			100.0	1
Air Defense Missile Maintenance (23)		100.0*		100.0	2
Ballistic/Land Combat Missile and Light Air Defense Weapons Systems Maintenance (27)		100.0*		100.0	2
Aviation Communications-Electronics Maintenance (28)		100.0*		100.0	2
Communications-Electronics Maintenance (29)		100.0*		100.0	2
Communications-Electronics Operations (31)		40.9	59.1*	100.0	2
EW/Intercept Systems Maintenance (33)		100.0*		100.0	2
General Engineering (51)	44.1	53.3*	2.5	100.0	3
Chemical (54)	97.3*	2.7		100.0	2
Ammunition (55)		100.0*		100.0	2
Mechanical Maintenance (63)		100.0*		100.0	2
Transportation (64)	81.7*	18.4		100.0	2
Aviation Maintenance (67)	71.0*	29.0		100.0	2
Administration (71)		22.6	77.5*	100.0	3
Automatic Data Processing (74)		50.4*	49.6	100.0	3
Supply and Service (76)	55.5*	3.9	40.6	100.0	3
Recruitment and Reenlistment (79)		100.0*		100.0	3
Telegraphic Engineering (81)		100.0*		100.0	3
Public Affairs and Audio Visual (84)[e]		70.6*	29.4	100.0	3
Medical (91)		96.5*	3.6	100.0	1

Table 3-1 Continued
Percent Distribution of Enlistees within Major Army Occupational Group by Career Management Field[a]

Career Management Field[e]	I[b]	T	S	Total[c]	Military Essentiality Code[d]
	Major Army Occupational Group				
Petroleum (92)	95.8*	4.2		100.0	2
Food Service (94)			100.0*	100.0	3
Law Enforcement (95)			100.0*	100.0	3
Military Intelligence (96)		100.0*		100.0	2
Band (97)			100.0*	100.0	3
EW Cryptologic Operations (98)		100.0*		100.0	1

a As of September 30, 1980.

b I = Infantry, T = Technical, S = Support.

c Rounded to 100.0 percent.

d Code 1 = High, 2 = Medium, 3 = Low.

e Career Management Field code in parenthesis.

* Major Army occupational group (major IDOS group) in which each MOS is classified in this study.

Source: Derived from data provided by the Defense Manpower Data Center and U.S. Army Concepts Analysis Agency.

C. Empirical Data Relating to the Current SRB Program

Empirical data on SRB payments matching the detail needed in this study, i.e., by MOS, zone, and pay grade, could not be retrieved by DMDC as of the study date. Despite this shortcoming, salient aspects of the current SRB program can be inferred from data provided by the U.S. Army Personnel Center (MILPERCEN) to see how they conform to the guidelines discussed earlier (see Tables 3-2 and 3-3).

As can be seen from Table 3-2, the total dollar value of new SRB payments made by the Army was $65.6 million in FY 1980. In FY 1982 $98.2 million was expended for new SRBs with an additional increase in the SRB budget planned for FY 1983. If planned expenditures for FY 1983 are realized, the number of new SRBs offered will increase while the average new SRB payment will fall. Thus, it appears that the Army may be opting to offer more but smaller reenlistment bonuses.

It is also noted from Table 3-2 that between FY 1980 and FY 1982 the average new SRB payment was higher in zone C than zone B and higher in zone B than in zone A. Given the positive relationship between retention rates and zone, it is not clear why bonus levels should be positively related to zone.[13] However, the proportion of the SRB budget in this zone and in zone C has consistently been smaller than that allocated to zone A where retention is lowest. Indeed, it is this allocation of the SRB budget within zones which is indicative of the emphasis given to the retention rate in management of the SRB program.

Table 3-2
New SRB Payments by Zone, FY 1981 - FY 1983

	Zone			
	A[a]	B	C	Total
FY 1980				
Total New Payments[b]	57.1	6.4	2.1	65.6
Number of New Payments[c]	14.1	1.2	0.4	15.8
Average New Payment[d]	4,040	5,207	5,930	4,155
FY 1981				
Total New Payments	77.3	41.0	2.0	120.3
Number of New Payments	14.9	6.7	0.3	21.9
Average New Payment	5,183	6,124	7,068	5,496
FY 1982				
Total New Payments	58.9	37.4	1.9	98.2
Number of New Payments	13.6	7.5	0.3	21.4
Average New Payment	4,341	4,973	6,325	4,591
FY 1983[e]				
Total New Payments	87.3	18.9	2.2	108.4
Number of New Payments	23.4	3.8	0.6	27.8
Average New Payment	3,737	4,912	3,482	3,894

a Zone A = 21 to 72 months, B = 73 to 120 months, C = 121 months to 14 years.

b In millions of dollars.

c In thousands.

d Total dollar value of new payments/number of new payments. The values in the table are calculated from the original data prior to rounding of the numerator and denominator.

e Budgeted for FY 1983. Actual payments FY 1980 - FY 1982.

Source: Unpublished data from the U.S. Army Personnel Center (MILPERCEN).

A more detailed view of the distribution of the SRB is obtained from Table 3-3. On average, in zone A bonus levels were higher in the Infantry and Technical specialties than in the Support specialties. In zone B, however, the average SRB level in the Support MOSs was not much different than in the other two major occupational areas. Nonetheless, even in this zone the smallest fraction of the SRB budget was allocated to the Support specialties; over all zones only $5.6 million of $120.3 million was spent in bonuses for the Support specialties.

Table 3-3
New SRB Payments by Major Occupational Groups and Zone, FY 1981

Major Army Occupational Group	Zone A[a]	Zone B	Zone C	Total[b]
Infantry				
Total New Payments[b]	45.4	26.2	0.3	71.8
Number of New Payments[c]	8.6	4.1	-[d]	12.7
Average New Payment[e]	5,297	6,392	8,000	5,657
Technical				
Total New Payments	27.6	13.8	1.5	42.9
Number of New Payments	5.2	2.4	0.2	7.8
Average New Payment	5,312	5,691	7,265	5,482
Support				
Total New Payments	4.3	1.0	0.2	5.6
Number of New Payments	1.2	0.2	-	1.4
Average New Payment	3,757	5,892	5,184	4,072
Total				
Total New Payments	77.3	41.0	2.0	120.3
Number of New Payments	14.9	6.7	0.3	21.9
Average New Payment	5,183	6,124	7,068	5,496

a Zone A = 21 to 72 months, B = 72 to 120 months, C = 121 months to 14 years.

b In millions of dollars.

c In thousands.

d Less than 500 new SRB payments.

e Total dollar value of new payments/number of new payments. The values in the table are calculated from the original data prior to rounding of the numerator and denominator.

Source: Unpublished data from the U.S. Army Personnel Center (MILPERCEN).

Chapter 3 Footnotes

1 Authority for the first reenlistment bonus was established in 1971. See U.S. Department of Defense, Manpower Personnel and Financial Management, Report on the Selective Reenlistment Bonus Program, May 1, 1982, p. 4. (Referred to below as Report on the Selective Reenlistment Bonus Program).

2 Ibid., pp. 6-8.

3 In special circumstances individuals can receive an SRB by reenlisting in a critical skill even though they are not qualified in that skill.

4 After FY 1983 enlistees who extend their military contract will be ineligible for an SRB.

5 Except for Navy nuclear personnel where the maximum is $20,000. Ibid., pp. 10-12.

6 Ibid., p. 12.

7 Third Quadrennial Review of Military Compensation, op.cit., p. 12.

8 Report on the Selective Reenlistment Bonus Program, op.cit., p. 12.

9 Loc.cit.

10 The variables included relate to retention, replacement cost, shortfalls, military essentiality, and size (i.e., the number of individuals in an occupation). See Patricia Griffin, A First-Term Attrition Severity Index for U.S. Navy Ratings, Naval Postgraduate School, June 1981, M.A. Thesis, pp. 91 and 109.

11 See U.S. Army Concepts Analysis Agency, Selective Reenlistment Bonus (SRB) Study, Bethesda, Md., August 1982, pp. 5-2 to 5-6. (Referred to below as Selective Reenlistment Bonus (SRB) Study).

12 See U.S. Department of Defense, Office of the Assistant Secretary of Defense, Manpower, Reserve Affairs, and Logistics, Occupational Conversion Manual: Enlisted/Officer/Civilian, September 1980.

13 The FY 1983 projection indicates SRB levels in zone C (but not zone B) are being reduced below that of zone A.

Chapter 4: A Human Capital Approach to Computing Selective Reenlistment Bonus Levels

The variables consistently referenced in discussions of the SRB are occupational shortfalls, retention rates, and training costs. An approach to handling these diverse aspects of the SRB decision process can be found in the literature on human capital theory.

Economists have been interested in the relationship between pay, training costs, and turnover since, at least, the 1960s.[1] More recently Goldfarb and Hosek have examined the question of which of two groups of workers, each having the same training costs and productivity but different turnover rates, a firm should hire.[2] Haber and Lamas have extended their model by relaxing the assumption of equal training costs and equal productivity so that one can now address the question of how much more a firm can pay a group of workers without raising labor costs, if as a result of paying a higher wage, the group's separation rate were to decline by a specified amount.[3]

In this chapter the extended model is applied to the SRB problem. The model assumes that firms maximize profits and labor markets are open and competitive. The military, of course, is a nonprofit organization, its labor market is a closed one, and there is only indirect competition with civilian sector labor markets. For this reason alone the model provides only a heuristic solution to a preferred SRB structure. Nonetheless the model has the important advantage of providing a rational and consistent way of setting SRB levels which explicitly takes into account differences in turnover, training costs, and outputs among groups of workers. Hence it represents a distinct advance over the current procedure.

A. The Basic Model

The basic model is set within the framework of the profit maximizing firm. It assumes that firms incur training costs for each employee hired and they must recover these costs over an employee's term of employment. The profit maximizing firm recoups its costs by paying employees less than the value of their output, i.e., less than their marginal value product. The difference between marginal value product and the wage rate, discounted to the present, and summed over all periods during which an employee remains in the firm's employ is the return to the firm on its investment in training. Since an employee may separate from a firm at any time, employers use an expected value calculation in which the discounted return in any period is multiplied by the probability that the worker will be in the firm's employ during the period. Profit is maximized when the number of employees hired is such that the expected present value of the return from offering training equals the cost of training. This equilibrium condition for maximizing profit is more formally expressed by

$$(1) \qquad \sum_{t=0}^{T} \left[\frac{MVP_t - W_t}{(1+r)^t} \right] (1-S)^t - C = 0$$

where T is the employer's time horizon, MVP_t and w_t are the marginal value product of labor and the wage rate in time period t, respectively, r is the discount rate, S is an employee's separation probability, and C is training costs. The term in brackets is the discounted return during period t; $(1-S)^t$ is the likelihood that the discounted return will be realized during the period. The product of these two terms is the expected present value of the return. The firm maximizes profits by hiring workers until the expected present value of the stream of returns falls into equality with the costs of training additional workers.

Assuming an employee's marginal value product, wage rate, and separation rate are constant through time and that the firm's time horizon is sufficiently long, the steady-state equilibrium condition is given by

$$(MVP - w) \frac{1+r}{r+s} - C = 0. \tag{2}$$

From equation (2), the wage differential between two groups of workers which leaves a firm indifferent between hiring one or the other when each group has the same marginal value product and the same training cost is found to be

$$w_1 - w_2 = \frac{C}{1+r} (S_2 - S_1). \tag{3}$$

As can be seen from equation (3), if group 2's separation rate exceeds that of group 1 workers, group 1 can be paid a higher wage.

B. The Extended Model

In the basic model it is assumed that the marginal value product and training costs of two groups of workers are equal. In this section the model is extended by removing these restrictions. As before, it is assumed that an employee's marginal value product, wage rate, and separation rate are constant through time and that the time horizon is long. Instead of assuming two groups of workers with the same marginal value product and the same training costs, we now assume these can differ, i.e., $MVP_1 \neq MVP_2$ and $C_1 \neq C_2$. Thus equation (2) can be rewritten as

$$(MVP_1 - w_1)\frac{1+r}{1+S_1} - C = 0$$

$$(MVP_2 - w_2)\frac{1+r}{1+S_2} - C = 0 .$$

Under these conditions the wage differential leaving a firm indifferent between the two groups can be shown to be

$$(4) \qquad w_1 - w_2 = (MVP_1 - MVP_2) + \left[\frac{C_2}{1+r}(1+S_2) - \frac{C_1}{1+r}(1+S_1)\right].$$

In estimating equation (4), the marginal value product is measured by annual earnings; the time interval for measuring S is a year; and the total cost of training is assumed to be expended at the moment of hire.

The wage rate is measured in dollars per year. In contrast to the models cited in the previous chapter, the variables in this model do not enter as a product scaled between 0 and 1.

From equation (4) one notes that for $MVP_1 = MVP_2$ and $C_2 = C_1$ the first term on the right equals 0 and the last two terms reduce to $\frac{C}{1+r}(S_2 - S_1)$, i.e., (4) reduces to (3) when the assumptions of the previous section are satisfied. Again it is seen that the group with the lower turnover (assumed to be group 1) is paid a higher wage, all other things being equal. Moreover, even when $C_1 = C_2$ the premium that can be paid group 1 increases proportionately with training costs. If group 1's training costs are also lower than group 2's (as well as its separation rate), the premium paid to the former group would be still higher.

C. Extending the Model to the Military Sector

As just indicated, in the civilian sector employers pay a premium to workers with a low separation rate, and the lower their training costs, the higher the premium they can pay. On the other hand, in the military sector it is desirable to pay bonuses to workers with a high separation rate, and the higher their training costs, the larger the bonus they should receive. Because of the arduous nature of military employment in some specialties, and because in some specialties enlistees can earn more in the civilian sector, turnover may be excessive. Indeed, the greater the training costs, the more likely are there to be opportunities for employment in the civilian sector. It is for these reasons that a SRB is provided to enlistees in selected MOSs so the investment made in such individuals is not lost to the military.

In establishing a wage and bonus structure for the military, attention should be given to the relationship between that structure and turnover. Consider the case of the Infantry specialties. One way of reducing turnover in these specialties is to offer a bonus, but how much should be offered? To answer this question, information is required about the functional relationship for infantrymen between changes in the separation rate and the bonus, and the reduction in the cost of acquiring and training infantrymen, given the decline in the separation rate when a bonus is offered. It should be clear from Chapter 2 that this information is not readily obtained given the state of the art in estimating the elasticity of reenlistement.

A much simpler approach and the one adopted in this study is to determine the bonus which would leave one indifferent between accessing and training infantrymen and, say, support specialists, presupposing that payment of the bonus would equalize the separation rate of both groups. It should be noted that what is important here is not whether the actual decline in the separation rate equals the presumed decline for any group , but rather the benefit that would accrue to the military, as measured by the wage premium it could offer, if the separation rate were to decline by a specified amount.

The benefit that would accrue to the military if the separation rate of, say, infantryment (group 1) were to decline to that of support specialists (group 2), can be written as

(5) $$w_1 - w_2 = (MVP_1 - MVP_2) + \left[\frac{C_1}{1+r}(1+S_1) - \frac{C_2}{1+r}(1+S_2)\right].$$

As in equation (4), a premium is given to the group with the higher value of output, in this case, in the military. The terms in the bracket, however, are reversed to take account of the difference noted above between the role of a wage premium in the military and civilian sectors. As can be seen from equation (5), a bigger bonus will be given to those MOSs[4] with high separation rates, high training costs, and large outputs. Since equation (5) yields a bonus structure that is consistent with the objectives of the SRB program, it tends to be effective. Also, since the larger bonuses are offered in those MOSs where retention is low, all other things being the same, equation (5) tends to be efficient. The benefit derived in using equation (5) in the manner suggested is that it provides an algorithm by which a bonus can be computed for each MOS vis-a-vis a base or standard group, e.g., a Support MOS.

While the model provides a basis for computing the bonus, s, for the problem at hand several modifications are needed. First, we define an adjusted bonus

(6) $$s^* = s-(RMC_1-RMC_2)$$

where

$s = w_1 - w_2$ as defined in equation (5) and

and $RMC_1 - RMC_2$ = the difference in regular military compensation between group 1 and group 2 workers.

The need to adjust s by the difference in regular military compensation

(RMC) between a given group 1 and the base or standard group 2 is due to our computing the SRB by pay grade and zone. In the present context, the bonus s measures the wage premium in the absence of differences in compensation between groups of workers. If the differential in compensation between the two groups equals s, it is clear that no bonus would be necessary to realign the pay structure. It is only when s exceeds the actual differential in pay that a realignment is needed; as indicated in (6), the realignment, all other things being the same, is given by $s - (RMC_1 - RMC_2)$.

A second iteration yields the algorithm used in our study to determine SRB levels, which we denote by s^{**}:

$$(7) \quad s^{**} = \mathrm{Min}\,(s^{*} \times E \times P \times G,\ \$16{,}000),\ H < \beta$$
$$= 0, \qquad H \geq \beta$$

where

E = a filter measuring the military essentiality of a MOS,

P = a filter to identify high performance soldiers,

H = a filter measuring shortfalls,

and G = a filter for adjusting SRB levels.

In addition to accounting for RMC, in calculating SRB levels one should also consider the importance of a MOS for accomplishment of the Army's mission objectives. In part, a MOS's importance is given by the marginal value product variable in equation (5), since this variable measures output at the margin of production. For example, radar repairmen are more likely than general office clerks to contribute to output independent of the sector, military or civilian, in which they are employed.

Hence one can use output as measured by earnings in the civilian sector as a proxy for output in the military. But the uniqueness of many military specialties suggests the need for another variable, in addition to output in the civilian sector, which more directly gets at the contribution of an MOS to Army mission capability. We denote this variable by E and use it to measure the military essentiality of a MOS. Needless to say, the development of military essentiality values is a research task in itself. It suffices at this point in the discussion to note that military essentiality codes (MECs) are best derived indirectly through a questionnaire approach rather than directly measuring it by selecting a value, say, between 0 and 100. Additionally, anchoring the military essentiality scale at 0 when the maximum essentiality value is large should be avoided.[5]

The filter E aims at improving SRB effectiveness by giving bonus preference to MOSs that are highly essential to Army readiness. But not all persons in these MOSs make effective soldiers. Likewise, effective soldiers can be found in other MOSs which are not of the highest essentiality. The filter P is designed to identify such individuals. This can be done by forming the ratio

$$P = \frac{\text{Length of service to achieve a given pay grade}}{\text{Average length of service to achieve the given pay grade}} .$$

Individuals who attain a given pay grade more rapidly than the time taken by the average individual can be presumed to be high performance soldiers.[6] All else being equal, the reenlistment of these individuals should contribute most to the Army's readiness. An alternative approach to evaluating a soldier's performance, say, by the assignment of a numerical or letter grade similar to those given students would yield a more accurate measure of an individual's military performance, but this may be impractical from the point of view of SRB management.

It is noticed that shortfalls enter into the computation of s^{**} as an override. In the model, H measures the fill rate, i.e., the percentage that operating strength comprises of authorized strength. A MOS with $H > 100.0$ indicates a surplus of personnel; MOSs with H values between 90.0 and 100.0 are considered to be in balance; MOSs with an H value of less than 90.0 are defined as being in short supply; in practice, SRBs are only given when $H < 90.0$.

The last filter, G, is used to adjust the bonus levels so that they are consistent with that of the FY 1981 SRB schedule. Consistency is defined here by constraining the model SRBs so that the computed SRB in pay grade E-4, zone A of the Infantry specialties approximately equals the average SRB actually paid to bonus recipients in zone A of the Infantry specialties in FY 1981, i.e., $5,297 (see Table 3-3). Additionally, in consonance with current SRB policy, in the calculation of s^{**} a maximum of $16,000 is used. Not indicated in the above formulation, since small values of s^{**} are possible, and it is costly to administer a program when many small SRBs are offered, a minimum SRB value is also used. SRBs below $1,000 are set equal to 0.

Chapter 4 Footnotes

1 See Gary S. Becker, Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education, Columbia University Press, 1964 and Walter W. Oi, "Labor as a Quasi-Fixed Factor," Journal of Political Economy, December 1962, pp. 538-555.

2 See Robert S. Goldfarb and James R. Hosek, "Explaining Male-Female Wage Differentials for the Same Job." The Journal of Human Resources, Winter 1976, pp. 98-108.

3 See Sheldon E. Haber and Enrique Lamas, "Pay, Training, Turnover, and Hiring and Retention Decisions," Journal of Behavioral Economics, Summer 1983, pp. 1-21.

4 Unless otherwise indicated, the references to MOS in this section should be understood to mean a MOS, zone, pay grade combination since the SRB computation is at this level of detail.

5 The outcome of anchoring a variable to a 0 base is that the bonus gradient with respect to military essentiality, or any other variable scaled in this manner, becomes very steep. The effect is to preclude the offering of an SRB even though other variables might indicate that it should be awarded.

6 It is of interest to note that the characteristics of individuals who are most likely to complete their first term of service are the same as the characteristics of persons who attain a given pay grade early, given that they complete their initial service contract. See Sheldon E. Haber, Factors Influencing Attrition in the Marine Corps, The George Washington University, Program in Logistics, Serial T-306, March 1975 and Sheldon E. Haber, Factors Influencing Trainability in the Marine Corps, The George Washington University, Program in Logistics, Serial T-314, April 1975.

Chapter 5: Separation Rates

The variables entering the model described in the previous chapter are the separation rate, training cost, and the value of output in the military sector. In this chapter we discuss the first of these variables, i.e. the separation rate. While the summary data presented here are by major Army occupational group, more detailed estimates by MOS were used in the actual model computations.

A. The Separation Rate and Measures of Retention

Although the model is couched in terms of the separation rate, it is initially more convenient to discuss measures of retention. The standard measure of retention is the unadjusted reenlistment rate which is defined as

(1) Reenlistees / (Reenlistees + Eligible separators).

Included in this measure are all individuals who reenlisted or separated (given they were eligible to reenlist) during a given year.[1]

Another useful way of computing the reenlistment rate is

(2) Reenlistees / (Reenlistees + Separators, including ineligible separators).

This rate is of some interest as it gives a more accurate representation of personnel losses. Although ineligible separators are not as qualified as eligible separators, the former like the latter embody human capital investments made by the Army.

Manpower losses to the Army may be inferred from still another measure called the continuation rate. A continuation occurs when an individual remains in the Army between two points of time, typically one year apart. The continuation rate is computed as

(3) Continuations / (Continuations + Noncontinuations)

where the denominator includes all persons in the Army at the initial time point and the numerator contains all continuators including non-reenlistees.

Still another measure of retention which is particularly important for the SRB problem relates to continuations in the same MOS. This measure which we denote as the "same MOS continuation rate" (SMOSCR), is defined as

(4) Continuations in the same MOS / (Continuations + Noncontinuations)

where the denominator is the same as in measure (3).

In this study, the separation rate, S, is one minus measure (4). The separation rate defined in this manner is analagous to the definition of turnover in the civilian sector. Conforming to standard practice, the time interval over which measure (4) is computed is one year.

It is to be emphasized that the more familiar measure of retention used by the military services, namely, the reenlistment rate, is not utilized in the SRB computation. Instead, the model requires that a continuation rate measure of retention be utilized. The reason for this is that in the model the SRB is based on the retention behavior of <u>all</u> individuals, rather than those classified as eligible for reenlistment after their performance on the job is observed over an extended period of time.[2] Moreover, of the two continuation rate measures defined above, measure (4) is the more appropriate one in the SRB context, since the skills specific to a MOS are, to an important extent, lost to the Army when enlistees transfer out of MOSs in which an SRB should be offered.

B. A Digression on Army Strength as of September 30, 1980

By way of illustrating the data pertaining to retention, it is useful to look first at the composition of the enlistee population. As of September 30, 1980, Army enlistee strength was 668,336 of which 43.8, 31.2, and 25.0 percent were in the Infantry, Technical, and Support specialties (see Table 5-1).

One question which arises with respect to the distribution of enlistees among the major Army occupational groups is how it changes by length of service, or in the SRB context, by zone. Migration between the occupational groups can be viewed in two ways. It may be deemed undesirable because it results in multiple and, therefore, higher training costs; on the other hand, it may be advantageous to have personnel trained in diverse skill areas. However, if the area where initial training is one in which an SRB should be offered, it can be presumed that the disadvantages of migration outweigh the advantages.

As indicated in Chapter 3, the major portion of the Army's SRB budget is allocated to the Infantry specialties. It is of some interest, therefore, to determine the extent to which there is migration out of the Infantry specialties and the specialties which out-migrants enter. Information pertinent to this aspect of manpower management is found in the top portion of Table 5-1. As can be seen from the figures shown, there is some migration out of the Infantry specialties as length of service increases, but it is not overwhelming. The percent of enlistees in the Infantry specialties declines from 47.7 to 39.5 between zones 1 and 5,[3] but this represents only a 17.2 percentage point decline.

Table 5-1

Percentage Distribution of Enlistees by Zone and Major Army Occupation Group, September 30, 1980

	Major Army Occupational Group			
	I[a]	T	S	Total[b]
Zone				
1[c]	47.7	28.9	23.4	100.0
A	44.0	31.0	25.0	100.0
B	38.9	34.3	26.9	100.0
C	37.4	36.1	26.5	100.0
5	39.5	33.2	27.3	100.0
Pay Grade				
E-1	50.7	26.9	22.4	100.0
E-2	49.4	29.7	20.9	100.0
E-3	45.3	29.5	25.2	100.0
E-4	44.7	29.9	25.4	100.0
E-5	37.8	34.8	27.4	100.0
E-6	41.0	34.1	24.9	100.0
E-7	37.0	36.1	26.9	100.0
E-8	43.6	31.9	24.6	100.0
E-9	43.6	25.2	31.2	100.0
Total	43.8	31.2	25.0	100.0

a I=Infantry, T=Technical, S=Support.

b Rounded to 100.0 percent.

c Zone 1 = length of service under 21 months, A = 21 to 72 months, B = 73 to 120 months, C = 121 months to 14 years, 5 = over 14 years.

Considering the Army's expressed preference for younger people in the Infantry specialties, this decline is at most a modest one. Additionally, migrants appear to shift into the Technical specialties, more so than the Support specialties. This is particularly true in zones A through C where the SRB is offered.

A second aspect of Table 5-1 worth noting is that the percentage of enlistees by major IDOS group is not very different among the various pay grades. There does appear to be a greater concentration of enlistees in the Technical specialties at the higher pay grades, but the increase, again, is at best modest. It is this fact coupled with the equal pay of individuals in the same pay grade, irrespective of military specialty, that is the stimulus for the SRB program.

Another very strong relationship, namely, between length of service and pay grade, is seen in Table 5-2. As can be seen from this table, zone A is comprised almost exclusively of E-4s and E-5s -- 87.1 percent of the enlistees in this zone fall into these two pay grades. In zone B, 90.1 percent of the enlistees are in pay grades E-5 and E-6. And enlistees in pay grades E-6 and E-7 comprise 87.7 percent of all enlistees in zone C. Given the absence of E-1s through E-3s and E-8s and E-9s in zones A to C, the present analysis is limited to pay grades E-4 through E-7.

C. Continuation Rates in the Same MOS

As noted, the measure of retention used in this study is the continuation rate in the same MOS (denoted as the CRSMOS). The empirical data for this measure is summarized in Table 5-3. In constructing this

Table 5-2

Percentage Distribution of Enlistees
by Zone, September 30, 1980

	Zone[a]				
Pay Grade	1[b]	A	B	C	5
E-1	34.2	1.1	0.2	-[c]	-
E-2	26.0	1.8	0.1	-	-
E-3	32.3	9.1	0.6	0.1	-
E-4	7.4	58.5	7.5	0.7	0.1
E-5	0.1	28.6	49.8	11.2	1.5
E-6	0.1	0.8	40.3	60.1	20.1
E-7	-	-	1.4	27.6	52.9
E-8	-	-	-	-	21.2
E-9	-	-	-	-	4.2
Total[d]	100.0	100.0	100.0	100.0	100.0

a Zone 1 = length of service under 21 months, A = 21 to 72 months, B = 73 to 120 months, C = 121 months to 14 years, 5 = over 14 years.

b I=Infantry, T=Technical, S=Support.

c Blank indicates that less than 0.5 percent of the enlistees in a specified zone are in the given pay grade.

d Rounded to 100.0 percent.

table, all gains during FY 1981, including new reenlistees and reenlistees with prior service who separated for more than 30 days, were added to the strength figures underlying Tables 5-1 and 5-2 to obtain a more accurate estimate of continuation rates, since some people who enter the Army during the fiscal year also leave during the year. Additionally, the count of continuators includes people who were accessed during the year. The need to take account of gains is particularly important in computing continuation rates for the E-1 pay grade. For the SRB problem, the inclusion of accessions during the fiscal year is less important but still desirable. One further point about Table 5-3: the figures in the table are weighted averages over the MOSs contained in each major Army occupational group.

Examination of Table 5-3 reveals some familiar patterns. In every case, the CRSMOS increases with pay grade, holding zone constant. (As noted, this is why it is inefficient to give the same bonus, all else being the same, to enlistees in the higher pay grades in a zone). Likewise, the CRSMOS tends to be higher in the zones with longer length of service, holding pay grade constant. One also notices that for the pay grades characterizing zone A, the CRSMOS is lowest in the Infantry specialties and highest in the Support specialties, which suggests, but does not confirm, that in this zone the largest SRBs should be given to enlistees in the former group and the lowest SRBs to enlistees in the latter group.[4] In the higher pay grades, however, a different pattern emerges; the lowest continuation rates are found in the Technical specialties, suggesting that SRB levels should be highest for this group of occupations in zones B and C.

Table 5-3

Continuation Rates in the Same MOS by Major Army Occupational Group, FY 1981

Major Army Occupational Group and Zone[a]	Pay Grade			
	4	5	6	7
Infantry				
A	61.7	71.3	-[b]	-
B	-	74.4	83.9	-
C	-	-	86.2	89.5
Technical				
A	63.4	73.4	-	-
B	-	74.4	80.9	-
C	-	-	83.4	85.2
Support				
A	66.5	73.4	-	-
B	-	77.0	83.3	-
C	-	-	87.0	89.7

a Zone A = 21 to 72 months, B = 73 to 120 months, C = 121 months to 14 years.

b Excluded from the analysis because of the small percentage of enlistees in the cell (see Table 5-2).

Chapter 5 Footnotes

1 The adjusted reenlistment rate is similar to measure (1) except that it includes only individuals whose service contract terminates in a given time period, e.g., FY 1981.

2 The continuation rate is a more accurate measure of supply than the reenlistment rate because the former indicates what percentage of individuals in an employer's entire work force will remain from one year to the next. This is not to say that the effect of the SRB on reenlistment rates is not of interest, e.g., knowledge of the reenlistment elasticity with respect to the SRB is necessary for the problem of matching projected SRB expenditures and the SRB budget.

3 Table 5-1 includes two zones besides the SRB zones A to C. These are zone 1, defined as less than 21 months of service, and zone 5, defined as more than 14 years of service.

4 As will be indicated later, when training costs and value of output in the military are taken into account, the model indicates that in zone A the SRB levels in the Technical specialties should be higher than those in the Infantry specialties.

Chapter 6: Training Costs

A major element in the replacement cost of a soldier is the investment which the Army makes in his training. While this particular cost is the only element of replacement cost included in the model as formulated in Chapter 4, other elements which should be included are recruitment and separation costs, e.g., unemployment insurance. In the SRB context these costs, like training costs, also represent savings that are realized when an incumbent in a position is retained. However, there is one separation cost which must be treated differently, namely, retirement cost. Since this cost may be expected to _rise_ pursuant to the offering of a bonus, it should be netted out in the calculation of replacement cost.

Thus, instead of training costs alone, the replacement cost relevant to the SRB calculation is:

Replacement Cost = Recruitment cost + Training cost + Separation cost, not including retirement cost - Expected incremental increase in retirement cost

Because the estimation of the large number of separation costs and of retirement cost entails an effort beyond the scope of this study, they are not considered here.

A. Recruitment Cost

The total cost incurred by the Army in recruiting active personnel during the second quarter of FY 1981 was $145 million.[1] This figure includes direct costs, such as identifying individuals interested in serving in the Army, testing potential enlistees, and enlistment bonuses; indirect costs, e.g., advertising and nonproduction personnel costs at recruiting stations; and overhead costs, e.g., costs of operating regional and headquarters recruiting commands and Armed Forces Examining and Entrance Recruiting Stations.[2] A breakdown of these cost categories on a per capita basis by level of education is provided in Table 6-1.

It should be noticed that the figures for high school graduates in Table 6-1 refer to individuals with a diploma. In contrast, the DMDC data, to which the recruitment cost estimates are applied, include recipients of a Graduate Equivalency Diploma (GED) among the count of high school graduates. It would have been desirable to distinguish between individuals with a GED and a "true" high school diploma in the DMDC data, but this was not possible. Hence our estimates attribute the higher recruitment cost of diploma graduates to a larger number of enlistees than, in fact, were actual diploma graduates.

The higher recruitment cost for high school graduates than for non-high school graduates, $4,048 versus $2,327, is attributable to the high school graduate being sought out by recruiters while the high school dropout is often a "walk-in" at recruiter stations. Additionally, only the former receive enlistment bonuses.

The direct costs in Table 6-1 are variable costs because they change

Table 6-1
Per Capita Active Army Recruitment Costs, FY 1981[a]

	Non-High School Graduate (Non-Diploma)	High School Graduate (Diploma)
Direct Costs	541	1,889
Enlistment Bonus	0	644
Other Direct Costs	541	1,245
Indirect Costs	1,342	1,715
Overhead Costs	444	444
Total, Including Enlistment Bonus	2,327	4,048
Total, Excluding Enlsitment Bonus	2,327	3,404

a Second quarter.

Source: Derived from U.S. Army, Office of the Auditor General, Audit of Cost of Recruiting, Report No. MW 82-701, 28 January, 1982, pp. 13 and 15.

with the number of enlistees. For example, the cost of enlistment bonuses only increases when additional enlistees are accessed into MOSs where such bonuses are given.[3] The indirect and overhead costs, however, are sunk costs which are fixed in the short run and independent of the number of persons accessed into the Army during any given year.[4]

Because high school graduates require numerous contacts before signing a contract whereas high school dropouts tend to be walk-ins, variable costs should comprise a higher proportion of recruitment cost for the former group than for the latter. This is indeed the case as can be inferred from Table 6-1 where variable, i.e., direct, costs (excluding enlistment bonuses) are 36.6 and 23.3 percent of recruitment costs (excluding enlistment bonuses) for high school and non-high school graduates, respectively. It should be noted our estimates differ from those in the Recruiting Cost Audit study where variable costs as percentage of recruitment costs (excluding enlistment bonuses from each category of cost) are lower for high school graduates, 31.8 percent, than for high school dropouts, 46.7 percent.[5]

In calculating the SRB, recruiting costs (excluding enlistment bonuses) were utilized. From Table 6-1, it is seen that these costs averaged $3,404 for high school graduates and $2,327 for non-high school graduates. Since our unit of observation is MOS, pay grade, and SRB zone, whereas the recruitment cost figures are by level of education, we weighted the two cost figures by the percentage of enlistees who were high school and non-high school graduates to arrive at a single value for each cell. Thus for MOS 11B, Infantryman, pay grade E-4, zone A in which 82.9 percent of the recruits were high school graduates in FY 1981, our estimate of recruitment costs was $3,220 (= .829 x $3,404 + .171 x $2,327). Similar figures by major Army occupational group are shown in Table 6-2.

B. Training Cost

The training cost figures used in this study, expressed in FY 1981 dollars, are taken from the Military Occupational Specialty Training Cost Handbook (MOSB).[6] They include only those costs incurred in formal training programs, i.e., <u>on-the-job training costs (OJT) are not included</u>. The formal training costs accounted for are (1) military pay and allowances for students, faculty, and training and support activity personnel, (2) operating expenses, e.g., for utilities and for training and support activities, (3) ammunition expended in training, and (4) the annual replacement cost of equipment. However, such costs as medical and retirement costs associated with the upkeep of personnel involved in the training process are not considered. Major construction and other identifiable one-time special expenses are excluded,[7] since these represent capital expenditures rather than outlays for operations.

The MOSB training costs are classified into variable and fixed costs. Variable costs, e.g., military pay and allowances for students, vary with student enrollment. On the other hand, fixed costs, e.g., equipment replacement cost, are constant in the short run and independent of student enrollment. For small changes in student enrollment levels only the variable component of training cost should be considered in

Table 6-2

Recruitment Costs, Excluding Enlistment Bonuses, by Major Army Occupational Group, January 1982

Major Army Occupational Group and Zone[a]	Pay Grade 4	5	6	7
Infantry				
A	3,258	3,349	-[b]	-
B	-	3,375	3,400	-
C	-	-	3,401	3,404
Technical				
A	3,314	3,371	-	-
B	-	3,390	3,402	-
C	-	-	3,404	3,404
Support				
A	3,326	3,380	-	-
B	-	3,393	3,402	-
C	-	-	3,403	3,401

a Zone A = 21 to 72 months, B = 73 to 120 months, C = 121 months to 14 years.

b Excluded from the analysis because of the small percentage of enlistees in the cell (see Table 5-2).

Source: U.S. Army, Office of the Auditor General, Audit of Cost of Recruiting, Report No. 82-701, 28 January, 1982.

estimating replacement cost. For purposes of this study it is assumed that school enrollments do change only marginally in the presence of the SRB program; hence the training cost figures in the SRB calculation include only the variable cost component of total training cost.

The MOSB formal training cost data fall into two categories. The first is reception and basic training costs which are the same for each MOS; the second is course costs which vary by MOS. In the MOSB, these costs are shown as cummulated training costs for skill levels 1 through 5 where the former corresponds to pay grade E-4 and the latter to pay grade E-8. As noted in the previous chapter, the relevant pay grades for the SRB problem are pay grades E-4 through E-7.

The <u>cumulative variable</u> training costs used in this study are summarized in Table 6-3 by major Army occupational group. The need for cumulative training costs is generated by the model in that the relevant cost is that which would be incurred if a given worker were replaced by another one of equivalent skill. The figures shown are simple averages over the MOSs in each major Army occupational group.

As can be seen from Table 6-3, by far the highest training costs are found in the Technical specialties. Training costs in these specialties are 58.2 percent higher than in the Infantry specialties in pay grade E-4; the differential declines among the higher pay grades but is still 34.1 percent higher in the former than in the latter specialties in pay grade E-7. Training costs in the Infantry and Support specialties are found to be about the same. Thus on the basis of training costs alone, one would want to give a bigger SRB in the Technical specialties.

Table 6-3

Cumulative Training Costs
by Major Army Occupational Group, October 1981

Major Army Occupatitional Group	Pay Grade 4	5	6	7
Infantry	8,591	11,114	16,511	21,589
Technical	13,593	16,871	23,141	28,948
Support	8,763	13,125	16,568	17,577

Source: U.S. Army Finance and Accounting Center, Cost Analysis Division, Military Occupational Specialty Training Cost Handbook (MOSB) Volume 1, Enlisted, October 1981.

Chapter 6 Footnotes

1 See U.S. Army, Office of the Auditor General, Audit of Cost of Recruiting, Report No. MW 82-701, 28 January, 1982, p. 1. (Referred to below as Recruiting Cost Audit).

2 Ibid., p. 13.

3 In the second quarter of FY 1981 the average cost of the enlistment bonus per enlistee was $644. The average cost of the bonus, given that an individual received a bonus, was $4,327 (derived from Ibid., p. 8). While not part of this study, it is clear that the model in Chapter 4 is also applicable to the problem of allocating enlistment bonuses.

4 Although enlistments are positively related to advertising costs, once an advertising budget is determined this cost element becomes fixed. In the long run, however, which in this case exceeds a year since advertising budgets are revised annually, advertising costs are variable. Advertising costs, which were allocated entirely to high school graduates (see Ibid., p. 10), comprised 22.2 percent of the indirect costs of $1,715 for this group.

5 See Ibid., pp. 13 and 15. The difference between our figures and those derived from the Recruiting Cost Audit study is due to differences in the allocation of general indirect costs by level of education. Since indirect costs are fixed, we allocated the total of such costs, exclusive of advertising costs, $52,781,859, equally among all 40,090 contracts written in the second quarter of FY 1981. The advertising costs (see Ibid., pp. 7, 8, 10, and 12) of $11,845,471 were also allocated equally but only among the 31,722 high school enlistees on the assumption that non-high school enlistees would have entered the Army in the absence of such outlays.

6 U.S. Army Finance and Accounting Center, Cost Analysis Division, Military Occupational Specialty Training Cost Handbook (MOSB), Volume 1, Enlisted, October 1981. (Referred to below as MOSB data).

7 Ibid., pp. I-A-1, 2, and 4.

Chapter 7: Civilian Earnings in Occupations Analogous to Military Specialties

In the civilian sector the value of a worker's output is assumed to be measured by earnings. The mechanism which permits valuation of physical output in money terms is the pricing system. Since there is no market for national security, the same evaluation of a soldier's output is not possible. Yet it seems reasonable to assume that, for the most part, there is a rough correspondence between the value of output in military specialties and in civilian occupations which require similar labor inputs. This is the approach used to measure marginal value product in the military, i.e., MVP in our model.

In approximating the value of output in the military sector , military and civilian occupations were aligned as shown in Table 7-1. It will be noticed that the infantry specialties for which there are no equivalent civilian occupations are assumed to correspond to the operative occupations. These specialties are assumed to have higher skill requirements than the laborer occupations but lower skill requirements than the craftsman occupations. Moerover, a significant fraction of personnel in the infantry are involved in transport; this latter job group would be classified among operatives in the civilian sector.

In determining the earnings of the civilian counterparts of military personnel, a regression model was formulated. Given the context of the

Table 7-1
Major Civilian Occupational Groups Corresponding
to Major Army Occupational Groups

Major Army Occupational Group	IDOS One-Digit Subgroup	Major Civilian Occupations
Infantry:		
Military-Unique Personnel	T	Operatives, including transportation equipment operatives (601-715)[a]
Laborers, Operators, and Routine Maintainers	R	Operatives, including transportation equipment operatives (601-715)
Technical:		
Technical Personnel	G	Technicians (080-085 and 150-173)
Craftsmen, Mechanics, and Production Workers	P	Craftsmen and kindred workers (401-580)
Support:		
Clerical Personnel	J	Clerical and kindred personnel (301-395)
Service Personnel	M	Service workers, excluding private household (901-965)

a Census occupation codes shown in parenthesis. See U.S. Department of Commerce, Bureau of the Census, 1970 Census of Population, Classified Index of Industries and Occupations, 1971, pp. 10-14.

study and the available data, the model was specified as follows:

$$\ln E = a + bX_1 + cX_2 + \varepsilon$$

where ln E is the natural log of the earning of full-year, full-time civilian workers; X_1 represents experience, defined as age - years of education - 6 years; X_2 denotes years of education; and ε is the error term. The data are restricted to males age 18-32, excluding individuals with only an elementary school education or who graduated from college.[1] Age and education were entered into the regression equation as continuous variables. The data utilized were from the March 1982 Current Population Survey conducted by the Bureau of the Census in which earnings information can be obtained for individuals who worked full-year, full-time in 1981.[2]

The regression model was run separately for the six occupational groupings in Table 7-1. It should be noticed that the same regression equation is used to estimate the output of both IDOS subgroups T and R, i.e., the subgroups defining the Infantry specialties. Thus, whereas there are 6 IDOS subgroups, there are only 5 different estimating equations. The model results are shown in Table 7-2. From this table, it is seen that, as expected, earnings are positively related to both experience and education. All the coefficients have the correct sign and all but one are significant at the 0.01 level of significance; the remaining coefficient is significant at the 0.05 level of significance. In all but one instance, the return to education is greater than the return

Table 7-2

Estimated Regression Coefficients[a] from Earnings Equations for Civilian Occupations Corresponding to IDOS Subgroups

IDOS	Constant	X1 (Experience)	X2 (Education)	R^2
Military-Unique Personnel, T	8.484 (0.116)	0.029 (0.004)	0.064 (0.008)	.09
Laborers, Operators, and Routine Maintainers, R	8.484 (0.116)	0.029 (0.004)	0.064 (0.008)	.09
Technical Personnel, G	8.833 (0.312)	0.054 (0.013)	0.033 (0.020)	.23
Craftsmen, Mechanics, and Production Workers, P	8.507 (0.141)	0.037 (0.005)	0.063 (0.010)	.09
Clerical Personnel, J	8.442 (0.224)	0.037 (0.008)	0.058 (0.015)	.11
Service Personnel, M	7.734 (0.215)	0.044 (0.008)	0.090 (0.015)	.13

a Standard errors of the regression coefficients are in parentheses.

to experience. The percentage of the variation in earnings explained by the experience and education variables, however, is not large; for the technician occupations it is 23 percent, but less is explained in the case of the other occupational subgroups. The primary reason for the low R^2 values is the homogeneity of the population. Not only are women excluded, but the high paying professional and managerial occupations, as well as the low paying laborer occupations, are also excluded. Moreover, the experience and education variables are constrained to younger persons who attended high school but did *not* complete college.

Notwithstanding the relatively low predictive value of the model, there are noticeable differences in earnings in the sample population, as reflected by the figures in Table 7-3. The earnings figures in this table were derived as follows: For non-high school (high school) graduates, it was assumed that years of experience was equal to two (one) year plus length of military service. Length of military service was then computed for each MOS, pay grade, SRB zone, and education (high school or non-high school graduate) combination; all the enlistees in a cell were assumed to have the same length of service and, hence, experience. Given the experience and associated educational level for a cell,[3] the antilog of the dependent variable in the appropriate regression equation was then computed. The earnings figures derived in this manner were then weighted by the fraction of high school and non-high school graduates having the same MOS, pay grade, and SRB zone characteristics, thereby taking account of education in estimating earnings, but simplifying further calculations by reducing the matrix of observations from four to three dimensions.[4]

Table 7-3

Estimated Value of Output (Earnings) of Enlistees by Major Army Occupational Group, 1981

Major Army Occupational Group and Zone[a]	Pay Grade 4	5	6	7
Infantry				
A	11,860	17,575	-[b]	-
B	-	13,993	14,598	-
C	-	-	16,755	16,939
Technical				
A	12,247	12,986	-	-
B	-	14,690	15,378	-
C	-	-	17,866	17,993
Support				
A	9,276	9,986	-	-
B	-	11,363	11,658	-
C	-	-	13,542	14,224

a Zone A = 21 to 72 months, B = 73 to 120 months, C = 121 months to 14 years.

b Excluded from the analysis because of the small percentage of enlistees in the cell (see Table 5-2).

Finally, it should be noted that the figures in the table are simple averages of the earnings in each MOS aggregated over the three major Army occupational groupings.

As can be seen from Table 7-3, the estimates of the value of military output are positively related to SRB zone, holding pay grade constant. Of greater interest, the value of military output rises with pay grade, holding SRB zone constant. Holding SRB zone constant on average, the value of output among pay grades rises by 3.8, 3.8, and 5.1 percent in the Infantry, Technical, and Support specialties, respectively. Comparing the value of output in pay grades E-4 and E-7, one notes that it is higher in the latter pay grades by 42.8, 46.9, and 53.3 percent in the Infantry, Technical, and Support specialties, respectively.

Of particular relevance to the SRB calculation, the value of output is highest in the Technical occupations. Comparing the Technical and Infantry specialties, it is found that the marginal revenue product is 3.3 percent higher in the former than in the latter specialties in pay grade E-4; the relative differential increases progressively to 5.9 percent in pay grade E-7. Substantially larger relative differentials, ranging from 26.5 to 32.0 percent, are observed when the Technical and Support specialties are compared.[5] Considering only the information pertaining to the value of military output, the largest SRBs should be given to the Technical specialties.

Chapter 7 Footnotes

1 Data for males are used because the bulk of the Army is comprised of males, and there is no reason to believe that the military output of women differs from that of men. Only 1.3 percent of Army enlisted personnel graduated from college in FY 1981, hence the educational restriction. See U.S. Department of Defense, Directorate for Information Operations and Reports, Selected Manpower Statistics, FY 1981, p. 62.

2 Full-year workers are those who work 50-52 weeks; full-time workers are those who usually work 35 hours or more per week.

3 Enlistees in a cell containing high school (non-high school) graduates were assumed to have completed 12 (11) years of school.

4 Thus, while enlistees were classified by MOS, pay grade, SRB zone, and education to estimate earnings, the education variable was eliminated from the SRB model by weighting for the educational composition in each MOS, pay grade, and zone combination.

5 For a comparison of how regular military compensation, RMC varies by major Army occupational group, pay grade, and zone, see Chapter 8.

Chapter 8: Modifications to the Initial SRB Calculation

In addition to the three variables -- the separation rate, training cost, and the value of output -- underlying the basic extended model -- other information, designated as filters, is needed for the SRB calculation described in Chapter 4. These filters are discussed in greater detail in this chapter. Also discussed is the calculation of regular military compensation.

A. Military Essentiality

As noted, the value of output of full-year, full-time workers in the civilian sector provides only an imperfect measure of the contribution of enlistees to national security. This is illustrated by MOS 11B, Infantryman, for which there is no civilian counterpart occupation. As a means of reducing the distortion that may be introduced by use of civilian occupational data as a proxy for the value of output in military specialties, we include a filter which measures the military essentiality of a MOS in the SRB calculation.

Military essentiality can be derived indirectly through a questionnaire approach or estimated directly by asking individuals to rate MOSs in terms of their relative importance to mission readiness. Although we believe the indirect questionnaire approach is preferred, the implementation of this approach is beyond the scope of the study. As an alternative we used the military essentiality codes (MECs) developed by the U.S. Army Concepts Analysis Agency (CAA). The agency asked up to 10 managers and decision makers in the U.S. Army Military Personnel Center and in the Office of the Deputy Chief of Staff for Personnel to rate the military essentiality of each CMF, where military essentiality was defined as "the relative importance of an MOS that makes it indespensable in the conduct of the combat mission of the Army."[1] In the CAA procedure, the mission essentiality of a CMF was coded 1, 2, or 3 by each participant with 1 corresponding to most essential and 3 to least essential. Each participant's military essentiality rating (MEC) was then weighted to obtain an overall MEC for a CMF. The MOSs belonging to each CMF were then assigned the overall MEC of their parent CMF.[2]

The CAA data indicate the number of participants choosing a MEC of 1, 2, or 3 to describe the military essentiality of a CMF. Instead of the CAA's weighting formula, we used a plurality rule in assigning an overall MEC to each CMF. For example, in CMF 54, there were 3 "votes" for rank 1, 4 for rank 2, and 3 for rank 3. This CMF was assigned an MEC of 2.[3] As in the CAA procedure, we assigned the CMF's military essentiality code to each MOS comprising the CMF. The MECs used in this study are shown in Table 3-1. A review of Table 3-1 indicates the following distribution of CMFs classified by MEC and major Army occupational group:

	Major Army Occupational Group			
MEC	I	T	S	Total
1	4	3	0	7
2	4	8	1	13
3	1	5	4	10
Total	9	16	5	30

As can be seen from this distribution, the Infantry specialties have the highest MEC codes; the lowest MEC codes are found in the Support specialties.

Having determined the military essentiality code of a CMF, we next converted the <u>ordinal</u> MEC to the <u>cardinal</u> value of E in the model (see Chapter 4). The functional relationship used was one developed in stocking Polaris submarines.[4] In particular, we derived the cardinal E values from the ordinal MEC codes us g the relationship

$$E = e^{-A(MEC-1)} \qquad \text{where MEC} = 1, 2, \text{or } 3.$$

For the value of A used in this study, i.e., A = 0.70, the values of E corresponding to the MEC codes are

MEC	E
1	1.00
2	0.50
3	0.25

Thus, everything else the same, the SRB in MOSs with a military essentiality code of 2 and 3 will be one-half and one-quarter, respectively, of the SRB in MOSs with an MEC of 1. It should be recognized that our choice of A, while judged to be reasonable, is arbitrary, and that the preferred value is best determined by the Army.

B. Shortfalls

One important way in which the effectiveness of the SRB is maintained is to offer it only in MOSs where there is a shortfall. The measure of shortfalls employed in this study is the percentage that operating strength comprises of authorized strength.[5] As a first approximation, it is tempting to use the overall fill rate for an MOS in determining whether a SRB should be offered in a specialty. A problem with this procedure is that while the overall fill rate may indicate that a MOS is in balance, the fill rate for some pay grades may indicate a shortage. This possibility, which is not atypical, can be illustrated by reference to MOS 16E, Hawk Fire Control Member.

The fill rate for MOS 16E, Hawk FC Crew Member, was 108.1, suggesting a surplus of personnel.[6]

Pay Grade	Fill Rate
E-1/E-3	186.5
E-4	75.6
E-5	108.7
E-6	76.9
E-4 and E-5	83.3
E-5 and E-6	89.4
E-4 to E-6	81.5
E-1 to E-6	108.1

A more accurate representation of supply-demand conditions in this MOS, however, can be obtained by considering the career fill rate, i.e., the fill rate for pay grades E-4 and higher, which is seen to be 81.5. The fill rates for pay grades E-4 to E-6 indicate a shortage of personnel. Even in this case, an apparent surplus is found for pay grade E-5.

The problem of determining whether a shortfall exists and should be reduced by offering a SRB is complicated by the fact that the supply-demand relationship in one pay grade cannot be determined independently from that in another pay grade. One way of getting at this problem is to estimate the *expected* fill rate for a pay grade which takes into account the likelihood of an individual continuing in an MOS and the likelihood of promotion. The expected fill rate, E (Fill Rate), could be calculated as follows:

E (Fill Rate) = [(Strength in pay grade i at the beginning of the year

X Continuation rate (in the same MOS and pay grade))

+ (Strength in pay grade i-1 at the beginning of the year

X Promotion rate from pay grade i-1 into pay grade i in the same MOS))

+ Transfers into pay grade i from other MOSs]

/ Authorized strength in pay grade i.

Since this approach requires extensive programming, it was judged to be beyond the scope of the study. Instead, the fill rate was computed for pay grades E-4 and E-5, pay grades E-5 and E-6, and pay grades E-6 and E-7, for zones A, B, and C, respectively. For MOS 16E, these fill rates are found to be 83.3, 89.4, and 76.9 (for pay grade 6 only).[7] Assuming a shortage of personnel exists when the fill rate falls below 90.0, it is seen from the figures shown above that a shortage of personnel is indicated in MOS 16E in every zone.

The results of applying the aforementioned procedure are shown in Table 8-1. The figures in this table show the number and percentage of

MOSs with a shortfall, defined as $H < 90.0$, by major Army occupational group and SRB zone. As can be seen from the table, in FY 1981 shortfalls were most prevalent in zone A and in zone C for the Infantry specialties.

C. High Performance Soldiers

As indicated in Chapter 4, it is desirable to give bigger bonuses to the more effective soldiers. One way of identifying a high performance soldier is by the time taken to attain a given pay grade relative to other soldiers. Since this information pertains to each individual soldier, it cannot be included in the SRB calculation before the fact. Hence we assume that

$$P = \frac{\text{Length of service to achieve a given pay grade}}{\text{Average length of service to achieve the given pay grade}}$$

equals 1.0 for every enlistee. This means that the filter P is, effectively, neutral with respect to the SRB calculation.

D. Additional Overrides

In order to insure that the proposed SRB schedule is conformable with the current one, several adjustments are necessary. First, it is necessary to impose an upper bound on the SRB; in consonance with current SRB policy, this upper bound is set at $16,000. Second, to avoid uneconomically small SRBs, a lower bound of $1,000 was established; computed SRBs smaller than this amount were set equal to zero. Third,

Table 8-1

Number and Percentage of MOSs with a Shortfall[a] by Major Army Occupational Group

Major Army Occupational Group	SRB Zone[b] A	B	C
Infantry			
Number of MOSs	27	23	28
Percent of MOSs with a shortfall	42.2	35.9	43.1
Technical			
Number of MOSs	62	58	50
Percent of MOSs with a shortfall	42.8	38.4	37.6
Support			
Number of MOSs	20	16	16
Percent of MOSs with a shortfall	45.5	34.0	37.2

a Defined as operting to authorized strength less than 90 percent.

b Zone A = 21 to 72 months, B = 72 to 120 months, C = 121 months to 14 years.

the model provides for a filter G which can be used to modify the SRB levels so that the proposed and current SRB schedules are pegged to a common point. The common point is chosen as the average bonus level in zone A for the Infantry specialties in FY 1981.

E. The Interest Rate

In calculating the SRB levels, it is necessary to determine a discount rate r. While there is much debate concerning the appropriate discount rate for problems in which there are tradeoffs in resource use, we use a discount rate of 10 percent. For the SRB problem, the choice of r is not as important as in other studies, since there is typically a constraint which must be met. In this study, the constraint is the matching of the model and current SRB levels for the Infantryman specialties in zone A.

F. Regular Military Compensation

Because the model yields SRB values which vary by pay grade and zone, it is necessary to take account of regular military compensation (RMC) in the SRB calculation. Our computation of RMC is based on the FY 1981 pay schedule. For each MOS, pay grade, and zone, average length of service was determined and then RMC was computed for the pay grades relevant to each zone. The RMC values calculated in this manner are provided in Table 8-2.

As is to be expected, there is little variation in RMC between major Army occupational groups, holding pay grade and SRB zone constant. In contrast, the value of military output, i.e., MVP in the model, was found to be higher in the Technical specialties than in the Infantry and Support specialties (see Chapter 7).

The largest variations in RMC, of course, are among pay grades. Holding SRB zone constant, on average, RMC among pay grades increases by 12.6, 12.4, and 12.5 percent in the Infantry, Technical, and Support specialties. Comparing RMC in pay grades E-4 and E-7, it is found that it is higher by 55.2, 54.4, and 54.5 percent, respectively, in the Infantry, Technical, and Support specialties. These figures are larger than the corresponding MVP figures, suggesting that RMC may rise at a faster rate than earnings in the civilian sector. This is seen more clearly by comparing the RMC and MVP figures for pay grades E-4 and E-7. For pay grade E-4, RMC exceeds MVP by 2.5, 0.6, and 31.1 percent in the Infantry, Technical, and Support specialties. The corresponding figures for pay grade E-7 are 11.3, 4.7, and 32.6 percent.

Table 8-2

Regular Military Compensation by
Major Army Occupational Group

Major Army Occupational Group and Zone[a]	Pay Grade 4	5	6	7
Infantry				
A	12,153	13,919	-[b]	-
B	-	14,526	16,278	-
C	-	-	16,949	18,863
Technical				
A	12,174	13,896	-	-
B	-	14,534	16,212	-
C	-	-	16,883	18,831
Support				
A	12,167	13,858	-	-
B	-	14,521	16,189	-
C	-	-	16,785	18,798

a Zone A = 21 to 72 months, B = 73 to 120 months, C = 121 months to 14 years.

b Excluded from the analysis because of the small percentage of enlistees in the cell (see Table 5-2).

Chapter 8 Footnotes

1 See Selective Reenlistment Bonus (SRB) Study, op.cit., p. 5-2.

2 Ibid.

3 For only two CMFs was there no plurality. In one case, 9 participants split their vote evenly between ranks 1, 2, and 3; the intermediate rank 2 was chosen for this CMF. In another case, 10 participants split their vote evenly between ranks 2 and 3. To be conservative the CMF was assigned a rank of 2.

4 For additional discussion, see U.S. Department of the Navy, Repair Parts Support Requirements for Special Projects Office Fleet Ballistic Missile Subsystem Equipment, SPINST P4423.27, 27 August 1963 and M. Denicoff, J. Fennell, S.E. Haber, W.H. Marlow, F.W. Segel, and Henry Solomon, "The Polaris Military Essentiality System," Naval Research Logistics Quarterly, December 1964, pp. 235-57.

5 The fill rate figures used in this study are from unpublished data, as of September 1980, provided by the U.S. Army.

6 The data for MOS 16E are for pay grades E-1 to E-6. Pay grades E-7 to E-9 are not defined for this MOS.

7 In each case, the fill rate is computed by combining the two pay grades. Thus, for zone A, the fill rate is for pay grades E-4 and E-5 taken together. Likewise for zones B (and C) pay grades E-5 and E-6 (E-6 and E-7) were combined. In some cases only one pay grade was represented in a zone, e.g., in MOS 16E, the highest pay grade is E-6. In this instance, the fill rate for pay grade E-6 by itself was used to determine if the MOS was in short supply in zone C. The rationale for this procedure is that the bulk of enlistees in zone A, B, and C are in pay grades E-4 and E-5, E-5 and E-6, and E-6 and E-7, respectively (see Chapter 5, particularly Table 5-2).

8 It should be noticed that SRBs can be given to E-3s although there are relatively few enlistees in this pay grade in zone A. For this study, it is assumed that E-3s would be given the same SRB as E-4s. Likewise, if a SRB is given to an E-4 (E-5) in zone B (C), the SRB is the same as that for an E-5 (E-6).

Chapter 9: SRB Levels Calculated from the Model

In the preceding chapters, the discussion has focused on the variables for which empirical data must be obtained to implement the proposed SRB model. These variables include the continuation rate, S; recruitment and training costs, together denoted as C; the value of military output as measured by earnings in the civilian sector, MVP; and regular military compensation, RMC. Additionally, values for military essentiality, E, the fill rate, H, and the budget filter, G, must also be determined.

As indicated in the model, not all variables pull in the same direction. For example, continuation rates are lowest in the lower pay grades, suggesting that the SRB should be concentrated in zone A. Cumulative training costs are higher in the higher pay grades, however, thereby suggesting a contrary conclusion. Likewise, the value of military output rises with pay grade, but the rise in this variable with respect to pay grade is not as rapid as the rise in regular military compensation with respect to pay grade, negating the need for an SRB in zones B and C. Shortfalls are also somewhat less prevalent in these zones. Similarly, except for the Support specialties, the preferred ordering of major Army occupational groups is not readily apparent.

In examining how the model operates, the value of s^* was computed first since it is free of filters and overrides. The s^* values are summarized in Table 9-1 by major Army occupational group. It will be recalled that the s^* values for a MOS are derived in terms of a base MOS and SRB zone. The base group in the computation is MOS 71L, Administrative

Specialist, which is a Support specialty; the base pay grade and zone are E-4 and zone A, respectively.[1] Because there is a base group, some of the SRBs as initially computed were negative. In Table 9-1, the negative SRBs are treated as if their value were zero. In this table and the subsequent ones in this chapter, the SRB values are simple averages aggregated over the MOSs in a major Army occupational group.

In assessing Table 9-1, it is noticed that the model SRBs for the Technical specialties are substantially larger than for the Infantry and Support specialties. Moreover, while in most instances the SRB levels for the Infantry specialties are higher than for the Support specialties, the differences are relatively small when compared to those between these specialties and the Technical specialties. The figures that stand out most strongly, however, are the high SRBs in zone C. The reason for this is the importance of training costs in the SRB calculation.[2]

The sensitivity of the model to training costs explains the high SRBs for the Technical specialties. For many MOSs in the Infantry and Support specialties, training costs are similar so that the SRB levels in these specialties do not diverge by much; for these two occupational groups the value of output variable is a primary determinant of the SRB level, particularly for pay grade E-4 in zone A. At higher pay grades, particularly in zone C, training costs are the most important determinant, so that even though separation rates are much smaller in zone C vis-a-vis zone A, the calculated SRB values are approximately twice as high in the latter zone as in the former. Likewise, within SRB zone the larger training costs at the higher pay grades have a greater effect on the SRB

Table 9-1

Model SRB Values, s*, by Major Army Occupational Group

SRB Zone[a] and Pay Grade	Average SRB[b]			Percentage of MOSs with SRB > 0		
	I[c]	T	S	I	T	S
A: E-4	5,650	11,773	3,592	89.9	93.8	76.7
E-5	6,373	13,182	6,959	89.9	90.7	84.8
B: E-5	7,104	14,092	8,233	92.4	91.4	83.0
E-6	10,443	18,782	8,699	94.0	91.6	83.7
C: E-6	11,361	19,413	9,465	94.0	93.6	87.5
E-7	14,424	23,856	10,002	83.6	84.8	73.2

a Zone A = 21 to 72 months, B = 72 to 120 months, C = 121 months to 14 years.

b Negative SRBs treated as if their value were zero.

c I = Infantry, T = Technical, S = Support.

level than the smaller separation rate (at the higher pay grades).

At the same time that the model points up how important training costs are for making preferred SRB decisions, it raises the question of how to explain the very high SRB values in zone C, given that the current SRB schedule provides only minimal emphasis to this zone.[3] The reason for this anomaly is that while training cost considered by itself argues for a high SRB in zone C, another important factor, namely, retirement cost, is not considered in the model. Providing a reenlistment bonus in zone C where enlistees have 10 to 14 years of service could induce them to continue in service until retirement. The additional cost incurred by such a policy may easily outweigh the savings in training cost which might be realized were individuals in zone C to reenlist for another tour of duty. Hence, the model results are most relevant to zone A where the likelihood is small that acceptance of a SRB will result in an individual continuing in military service till retirement (given that the person would not have done so in the absence of a SRB).

The large percentage of MOSs with a positive SRB in Table 9-1 is due to the selection of MOS 71L, Administrative Specialist, as the base group; for this group, training costs are relatively low so that the bulk of the MOSs are candidates for a SRB. As can be seen from comparing Panel A, Table 9-2 with Table 9-1, there is a substantial decline in the percentage of MOSs which would receive a SRB when the fill rate is considered. In zone A, for example, the percentage of MOSs with a positive SRB is reduced to between 31.9 and 40.4 percent. In general, when the fill rate is taken into account in the SRB calculation, the SRB levels rise; this is

Table 9-2

Model SRB Values, Modified by Filters and Overrides, by Major Army Occupational Group

SRB Zone[a] and Pay Grade		Average SRB			Percentage of MOSs with SRB > 0		
		I[b]	T	S	I	T	S
			Panel A[c]				
A:	E-4	5,604	12,260	3,452	39.1	39.1	37.2
	E-5	6,705	13,833	7,909	31.9	40.4	39.1
B:	E-5	7,949	17,300	8,933	36.4	36.4	29.8
	E-6	12,013	23,648	9,536	32.8	33.8	30.2
C:	E-6	12,093	23,247	13,110	41.8	37.9	32.5
	E-7	16,399	31,018	11,850	41.8	28.6	16.7
			Panel B[d]				
A:	E-4	4,736	7,251	1,162	39.1	39.1	37.2
	E-5	5,576	7,502	2,242	31.9	40.4	39.1
B:	E-5	6,727	9,638	2,411	36.4	36.4	29.8
	E-6	10,039	13,768	2,621	32.8	33.8	30.2
C:	E-6	9,955	13,465	3,865	41.8	37.9	32.5
	E-7	13,285	18,541	3,705	41.8	28.6	16.7

Table 9-2 continued

SRB Zone[a] and Pay Grade	Average SRB			Percentage of MOSs with SRB > 0		
	I[b]	T	S	I	T	S
			Panel C[e]			
A: E-4	5,247	7,308	1,942	34.8	28.1	14.0
E-5	5,724	6,896	2,702	37.7	36.0	30.4
B: E-5	6,636	8,304	2,922	36.4	34.6	23.4
E-6	9,731	10,924	3,033	32.8	33.1	25.6
C: E-6	9,487	10,526	4,147	41.8	27.9	30.0
E-7	11,518	12,803	3,706	41.8	28.6	16.7

a Zone A = 21 to 72 months, B = 72 to 120 months, C = 121 months to 14 years.

b I = Infantry, T = Technical, S = Support.

c Panel A: No SRB given in MOS-SRB zones with a shortfall, i.e., H < 90.0.

d Panel B: Figures in Panel A adjusted for military essentiality weight E.

e Panel C: Figures in Panel B adjusted for SRB maximum (minimum) -- $16,000 ($1,000).

particularly so in the Technical specialties where training costs are high to begin with, and indicates that training costs are substantially higher in MOSs where there is a shortfall. This is not at all surprising since it is the MOSs with the highest training costs for which civilian sector employment opportunities are most likely to be greatest.

When the military essentiality values, E, are applied, the SRB structure changes in still another way. As shown in Panel B, Table 9-2, SRB levels are reduced in all major Army occupational groups with the greatest reductions being registered in the Technical and Support specialties, particularly the latter where the average SRB for pay grade E-4, zone A is $1,162; moreover, even in zone C, the SRB average for the Support specialties increases to a maximum of only $3,685.

Another finding from Panel B is that even after adjusting for military essentiality, the differential between the SRB levels for the Technical and other specialties is significantly larger than the similar differentials under the current SRB procedure. This is the most important empirical finding of our study, and suggests that the SRBs for the Technical specialties should be raised vis-a-vis those in the Infantry specialties; it also suggests that a larger proportion of MOSs in which a SRB is offered should be in the Technical MOSs.

The last iteration in implementing the model involves (1) adjusting the SRB levels so the average SRB in pay grade E-4, zone A for the Infantry specialties approximates the corresponding SRB figure ($5,297) for the same zone and specialties in FY 1981; (2) setting a ceiling of $16,000 for each SRB; and (3) setting a floor of $1,000 by treating SRBs of less than this value as if they were zero. The results of this iteration are shown in Panel C, Table 9-2. It should be noted that, fortuitously, the value of G which satisfies the first of these three steps was 1.00; application of the second and third steps yields the figures in Panel C where it is seen that the average SRB in zone A for the Infantry specialties is $5,247. As expected, the result of this iteration is that the percentage of Support MOSs in which a bonus would be given is reduced, since it is these specialties where the SRB levels are lowest.

In concluding this chapter, we compare in Table 9-3 the distribution of MOSs by major Army occupational group based on the model and the current procedure as evidenced by the data underlying Table 3-3. For the reason cited above, the figures are restricted to zone A. As indicated by Table 9-3, the two distributions are quite similar.

It should be noted, however, that training cost figures are understated since they were not adjusted for attrition. Had adjusted training cost figures been used, it is likely that the representation of the Technical MOSs, among the MOSs in which a SRB is given by the model, would be substantially higher than shown in Table 9-3.

Table 9-3

Percentage Distribution of MOSs with a Positive SRB by Major Army Occupational Group, Zone A

Major Army Occupational Group	Model SRB[a]	Current SRB[b]
Infantry	32.0	28.1
Technical	60.0	64.8
Support	8.0	7.0
Total	100.0	100.0

a Pay grade E-4.

b FY 1981.

Chapter 9 Footnotes

1 It should be noticed that SRBs can be given to E-3s although there are relatively few enlistees in this pay grade in zone A. For this study, it is assumed that E-3s would be given the same SRB as E-4s. Likewise, if a SRB is given to an E-4 (E-5) in zone B (C), the SRB is the same as that for an E-5 (E-6).

2 Another reason, but one which is less important, is that the arithmetic mean is sensitive to outlyers, in this case, very large SRBs for particular MOSs.

3 The same question can be raised about the high SRB values in zone B, particularly for pay grade E-6. To a lesser extent, the answer here is the same as the one given in the text.

4 A detailed listing of MOSs and computed SRBs are available from the authors upon request.

Chapter 10: Conclusion and Suggestions for Further Research

The virtue of the model discussed in this study is that it provides a means for integrating a large set of variables in calculating an effective and efficient SRB schedule. In particular, the model takes account of retention rates, training costs, and the value of military output by MOS, pay grade, and SRB zone. The major conclusion of this research is that training costs are inadequately reflected in the FY 1981 SRB schedule. Were this factor given additional weight in the current SRB procedure, SRB levels would be increased in the Technical MOSs, and a larger proportion of MOSs in which a SRB is offered would be in these specialties.

It should be noted that the model as specified can be improved in several ways. The most important way in which this can be done is to include in the model the effect of the SRB on retirement costs. When an individual is induced to reenlist who might otherwise have not done so in the absence of a SRB, the likelihood of that individual remaining in service until retirement increases. Since retirement benefits are substantial, this raises the cost of offering a SRB; if retirement costs are not considered, this could lead to larger than optimal SRBs being offered. Indeed, this is clearly the case when the model is applied to zone C, and less so, but still the case, for zone B. A way of incorporating retirement costs in the model was developed but because of time limitations this part of the model could not be tested and is not discussed in this study.

Another area where the methodology can be improved pertains to training costs. The training cost estimates used in this study are not adjusted for attrition. The costs of replacing an enlistee in a given pay grade include the expenditures on individuals who are unable to rise through the ranks to fill the given individual's position as well as the expenditures on the individual who is ultimately successful in filling that position. A procedure for estimating training costs adjusted for attrition was developed, but again time limitations prevented its incorporation into the model calculations.

Still another aspect which deserves attention is how to tie the model to the budget process. Were information on reenlistment elasticities with respect to the SRB available, it would be possible to determine the expected outlays associated with a given SRB schedule and to compare these outlays with the available SRB budget. Adjustments to the SRB schedule or SRB budget could then be made before the schedule is implemented rather than after implementation.

As noted, we have used military essentiality codes derived from an earlier Army study in which a panel of experts was asked to assign a code of 1, 2, or 3 to measure the military essentiality of career management fields. Ideally, it would have been preferred if military essentiality codes had been available by MOS. It is believed that the preferred way of obtaining such information at this level of detail is through a questionnaire approach rather than directly asking individuals to rank each specialty.

Finally, information on enlistment bonuses was not used in estimating recruitment costs. One reason for this omission was the difficulty encountered in estimating the number of individuals by MOS who were potential candidates for the enlistment bonus in FY 1981. It is clear that the model of this study could also be applied to calculating enlistment bonus levels.